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## INFRARED VISIBLE LIGHT CONVERSION LIGHT EMITTING DIODE OF SMALL DIRECTIVITY

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Inventor(s): TOMIYAMA YASUYOSHI; others: 02  
Applicant(s): MITSUBISHI MATERIALS CORP  
Requested Patent: ☐ JP7193281  
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Equivalents:

### Abstract

**PURPOSE:** To remarkably reduce directivity and make possible clear indication in the case of large size, by fixing a fluorescent molded object which dispersedly contains infrared visible light conversion phosphor, so as to keep a specified distance from an infrared light emitting diode.

**CONSTITUTION:** A fluorescent molded object 2 is arranged in the manner in which the inner surface is positioned so as to keep a specified distance, e.g. 1.0mm, from the upper surface of a diode chip 1. For the purpose of protection, the whole part containing the fluorescent molded object 2 is packaged by using a transparent resin mold 7, and conversion light emitting diodes 1-3 are manufactured. A phosphor layer is formed as a dome type fluorescent molded body 2, which is arranged so as to keep a specified distance from the diode chip 1. Thereby the directivity caused by the difference of luminance in the observation direction is reduced, so that clear indication can be obtained.

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(54) 【発明の名称】 指向性の少ない赤外可視変換発光ダイオード

(57) 【要約】

【目的】 指向性の少ない赤外可視変換発光ダイオードを提供する。

【構成】 赤外発光ダイオードの放射する赤外光を赤外可視変換蛍光体を用いて可視光に変換して放射する赤外可視変換発光ダイオードにおいて、赤外可視変換蛍光体を分散含有するドーム状樹脂成型体を赤外発光ダイオードチップに対して所定の距離を設けて装着する。

## 【特許請求の範囲】

【請求項1】 赤外発光ダイオードの放射する赤外光を赤外可視変換蛍光体を用いて可視光に変換して放射する赤外可視変換発光ダイオードにおいて、赤外可視変換蛍光体を分散含有するドーム状樹脂成型体を赤外発光ダイオードチップに対して所定の距離を設けて装着してなる指向性の少ない赤外可視変換発光ダイオード。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】この発明は、表示用などに広く用いられている赤外可視変換発光ダイオード（以下、変換発光ダイオードという）に関するものである。

## 【0002】

【従来の技術】従来、一般に変換発光ダイオードは赤外発光部と赤外可視変換蛍光体含有樹脂層（以下、蛍光体層という）とそれを覆う透明樹脂モールドよりなり、赤外発光部は図2の概略断面図に示されるように赤外発光ダイオードチップ1（以下、ダイオードチップという）のN型層を金属ステム4Aに、同じくP型層をリード線6を亘て金属ステム4Bにボンディングしてなり、かつ金属ステム4A、4Bは端子5A、5Bと一体のものからなり、また前記蛍光体層8は赤外可視変換蛍光体（以下、変換蛍光体という）の粉末を分散含有するエポキシ樹脂をダイオードチップ1に塗布することによって形成され、赤外発光部と蛍光体層8が透明樹脂モールド7でパッケージされている。

【0003】また、上記変換発光ダイオードにおいては、端子5Aと5Bの間に電圧を加えてダイオードチップ1のPN接合面の近傍から赤外光を放射し、この赤外光が上記の蛍光体層8を通過する間に変換蛍光体に吸収されて特定波長の可視光に変換され透明樹脂モールド7を通して外部へ放出される。

## 【0004】

【発明が解決しようとする課題】しかし、近年変換発光ダイオードの大型化はめざましく、高い輝度を持つようになったが、上記の従来変換発光ダイオードにおいては蛍光体層が一般に塗布あるいは滴下などによってダイオードチップ上に形成されているので、均一な被覆が困難となるばかりでなく、この結果観察方向によって輝度が異なるという指向性があらわれ、表示が不鮮明にならざるを得ないというのが現状である。

## 【0005】

【課題を解決するための手段】そこで、本発明者らは上述のような観点から、大型化しても鮮明な表示の得られる、指向性の少ない発光ダイオードを開発すべく研究をおこなった結果、上記従来発光ダイオードにおける蛍光体層をドーム状の蛍光体成型体（以下、蛍光成型体という）とし、これをダイオードチップにたいして所定の距離を設けて設置した構造とすると観察方向による輝度の差に起因する指向性が少なくなって鮮明な表示が得られ

るという研究結果を得たのである。

【0006】この発明は、上記の研究結果にもとづいてなされたものであって、赤外発光ダイオードの放射する赤外光を変換蛍光体を用いて可視光に変換して放射する変換発光ダイオードにおいて、ダイオードチップに対して所定の距離を設けて蛍光成型体を装着することにより指向性を少なくした変換発光ダイオードに特徴を有するものである。

## 【0007】

【実施例】次に、この発明の変換発光ダイオードを実施例により具体的に説明する。表1に示される3種類の変換蛍光体を同表1に示される割合でエポキシ樹脂に分散混合し、これを外径3.0mm、高さ3.0mm、厚さ0.5mmの蛍光成型体とし、図1に見られるように前述の従来変換発光ダイオードにおける発光部と同じ構造を持つダイオードチップの上面にたいして1.0mmの距離を離れて内面が位置するように蛍光成型体を設置し、更に保護の目的で蛍光成型体を含む全体を透明樹脂モールド7でパッケージすることにより本発明変換発光ダイオード1～3をそれぞれ製造した。つぎに、この結果得られた本発明変換発光ダイオード1～3について、可視光の指向特性を評価する目的で端子5Aと5Bの間に約1.2ボルトの電圧を加え20mAの順方向の電流を流すことによってダイオードチップ1より赤外光を放射し、可視光の強度を変換発光ダイオードの中心線に対して30度の角度で透明樹脂モールド7の表面から30cm離れた位置で、水平面上円周方向に沿って60度毎に、光パワーメーターを用いて測定し、また前記中心線を含む垂直面上で、ダイオードチップ1を中心点として所定の傾斜角で測定し、中心線上で測定した強度を100として相対強度を算出し、この算出強度を表1に示した。

【0008】比較の目的で図2に示されるとおり、蛍光成型体に代わって平均厚さ0.5mmの蛍光体層を塗布するとともに、空間の形成なくパッケージすること以外は同一の条件で製造した従来変換発光ダイオード1～3について同一の条件で可視光の強度を測定し同じく相対強度を算出して表1に示した。

## 【0009】

【表1】

発光ダイオードの種類	発光ダイオードの組成	発光ダイオードの組成の割合 (%)	発光ダイオードの組成の割合 (%)	発光ダイオードの組成の割合 (%)									
				発光ダイオードの組成の割合 (%)									
				0度	60度	120度	180度	240度	300度	360度	光軸上	90度	120度
本発明変換発光ダイオード	1	$(Ba_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	10	50	80	80	80	80	80	80	100	80	30
	2	$(Ca_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	20	50	80	80	80	80	80	80	100	80	35
	3	$(Ca_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	30	50	80	80	80	80	80	80	100	80	35
従来変換発光ダイオード	1	$(Ba_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	10	50	60	45	60	45	45	45	100	80	5
	2	$(Ca_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	20	50	60	40	40	45	40	40	100	95	5
	3	$(Ca_{0.9}Sr_{0.1}Fe_{0.9}Cl_{0.1})_2$	30	50	60	35	50	30	30	30	100	95	5

〔0010〕なお、本発明発光ダイオードにおいては赤外光は透過するが可視光を反射する被膜で前記ドーム状成型体の内面をコーティングしたり、同じく外面を可視光は透過するが赤外光は反射する被膜でコーティング処理したりするとより一段と輝度を高めることが出来る。

さらに、発光部を保護するために蛍光成型体の内部を透明樹脂で充填してもよい。

〔0011〕

〔発明の効果〕表1から明かなように、本発明変換発光ダイオード1～3は従来変換発光ダイオードに比して観測の位置によるばらつきが著しく少なく均一な強度を示し、極めて指向性が少なく、従って、大型にしても鮮明な表示が可能となるなど工業上有用な特性を有する。

〔図面の簡単な説明〕

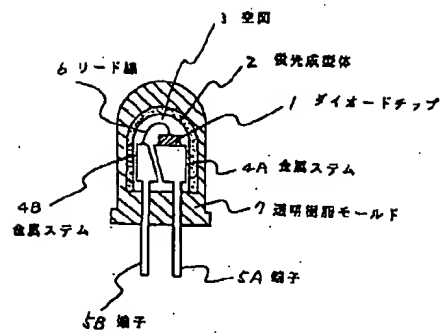
〔図1〕 本発明変換発光ダイオードの断面図

〔図2〕 従来変換発光ダイオードの断面図

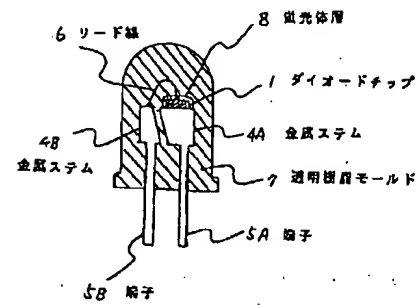
〔符号の説明〕

1. ダイオードチップ
2. 蛍光成型体
3. 空間
- 4 A. 4 B. 金属ステム
- 5 A. 5 B. 端子
6. リード線
7. 透明樹脂モールド
8. 蛍光体層

【図1】



【図2】



5/8

## PATENT ABSTRACTS OF JAPAN

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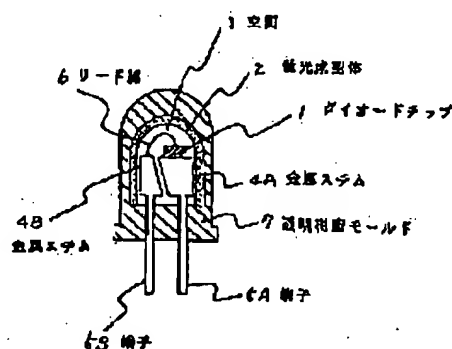
(72)Inventor : TOMIYAMA YASUYOSHI  
SHIRAISHI HIROYUKI  
ISHIWATARI MASA HARU

## (54) INFRARED VISIBLE LIGHT CONVERSION LIGHT EMITTING DIODE OF SMALL DIRECTIVITY

## (57)Abstract:

**PURPOSE:** To remarkably reduce directivity and make possible clear indication in the case of large size, by fixing a fluorescent molded object which dispersedly contains infrared visible light conversion phosphor, so as to keep a specified distance from an infrared light emitting diode.

**CONSTITUTION:** A fluorescent molded object 2 is arranged in the manner in which the inner surface is positioned so as to keep a specified distance; e.g. 1.0mm, from the upper surface of a diode chip 1. For the purpose of protection, the whole part containing the fluorescent molded object 2 is packaged by using a transparent resin mold 7, and conversion light emitting diodes 1-3 are manufactured. A phosphor layer is formed as a dome type fluorescent molded body 2, which is arranged so as to keep a specified distance from the diode chip 1. Thereby the directivity caused by the difference of luminance in the observation direction is reduced, so that clear indication can be obtained.



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CLAIMS

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[Claim(s)]

[Claim 1] Directive few infrared visible conversion light emitting diode which establishes a predetermined distance and comes to equip the dome-like resin molding object which carries out distributed content of the infrared visible conversion fluorescent substance to an infrared-emitting-diode chip in the infrared visible conversion light emitting diode which changes and emits the infrared light which an infrared emitting diode emits to the light using an infrared visible conversion fluorescent substance.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the infrared visible conversion light emitting diode (henceforth conversion light emitting diode) widely used for the display.

[0002]

[Description of the Prior Art] Generally conversion light emitting diode conventionally An infrared light-emitting part and an infrared visible conversion fluorescent substance content resin layer It becomes (calling it a fluorescent substance layer hereafter) from a wrap transparent resin mould about it As shown in the outline cross section of drawing 2, an infrared light-emitting part The infrared-emitting-diode chip 1 Similarly it comes to carry out the N type layer of (calling it a diode chip hereafter) bonding of the P type layer at metal stem 4B to metal stem 4A through lead wire 6. And the metal stems 4A and 4B consist of a thing of Terminals 5A and 5B and one. Moreover, the aforementioned fluorescent substance layer 8 is formed by applying to the diode chip 1 the epoxy resin which carries out distributed content of the powder of an infrared visible conversion fluorescent substance (henceforth a conversion fluorescent substance), and the infrared light-emitting part and the fluorescent substance layer 8 are packed by the transparent resin mould 7.

[0003] Moreover, in the above-mentioned conversion light emitting diode, while applying voltage, emitting shell infrared light near the PN-junction side of the diode chip 1 among Terminals 5A and 5B and this infrared light's passing the above-mentioned fluorescent substance layer 8, it is absorbed by the conversion fluorescent substance, is changed into the light of specific wavelength, and is emitted to the exterior through the transparent resin mould 7.

[0004]

[Problem(s) to be Solved by the Invention] However, although enlargement of conversion light emitting diode is remarkable in recent years and it came to have high brightness, since the fluorescent substance layer is generally formed on the diode chip of an application or dropping in the above-mentioned conventional conversion light emitting diode, the present condition is uniform covering not only becomes difficult, but that the directivity that brightness differs cannot but appear and a display cannot but become indistinct by the observation direction as a result.

[0005]

[Means for Solving the Problem] Then, even if it enlarges, as for this invention persons, a clear display is obtained from the above viewpoints. The result which inquired that directive few light emitting diode should be developed, The fluorescent substance layer in light emitting diode conventionally [ above-mentioned ] A dome-like fluorescent substance molding object When it presupposed (It is hereafter called a fluorescence molding object) and was the structure which prepared so predetermined a distance in the diode chip, and installed this in it, the research result that the directivity resulting from the difference of the brightness by the observation direction decreased, and a clear display was obtained was obtained.

[0006] This invention is made based on the above-mentioned research result, and has the feature in the conversion light emitting diode which lessened directivity in the conversion light emitting diode which changes and emits the infrared light which an infrared emitting diode emits to the light using a conversion fluorescent substance by establishing a predetermined distance to a diode chip and equipping with a fluorescence molding object.

[0007]

[Example] Next, an example explains the conversion light emitting diode of this invention concretely. Distributed mixture of three kinds of conversion fluorescent substances shown in Table 1 is carried out at a rate shown in this \*\* 1 at an epoxy resin. This is made into a fluorescence molding object with the outer diameter of 3.0mm, a height [ of 3.0mm ], and a thickness of 0.5mm. A fluorescence molding object is installed so that 1.0mm distance may be left so much on the upper surface of a diode chip with the structure same so that drawing 1 may see as the light-emitting part in the above-mentioned conventional conversion light emitting diode and an inside may be located in it. Furthermore, this invention conversion light emitting diodes 1-3 were manufactured, respectively by packing the whole which includes a fluorescence molding object for the purpose of protection by the transparent resin mould 7. Next, about this invention conversion light emitting diodes 1-3 obtained as a result Infrared light is emitted from the diode chip 1 by applying the voltage of about 1.2 volts among Terminals 5A and 5B in order to evaluate the directional characteristics of the light, and passing current with a forward direction of 20mA. Visible luminous intensity in the position which is distant from the front face of the transparent resin mould 7 30cm at the angle of 30 degrees to the center line of conversion light emitting diode On the vertical plane which measures using a light power meter along with a level surface top circumferential direction every 60 degrees, and includes the aforementioned center line, relative intensity was computed by having set to 100 intensity which measured with the predetermined tilt angle and was measured on the center line by having made the diode chip 1 into the central point, and this calculation intensity was shown in Table 1.

[0008] While applying the fluorescent substance layer with an average thickness of 0.5mm instead of the fluorescence molding object as shown in drawing 2 for the comparative purpose, except packing without formation of space, visible luminous intensity was conventionally measured on the conditions same about the conversion light emitting diodes 1-3 manufactured on the same conditions, similarly relative intensity was computed, and it was shown in Table 1.

[0009]

[Table 1]

	種別	交換蛍光体の種類	樹脂との 配合割合 (%)	測定波長 (nm)	放射可能視光の相対強度 (光軸上の強度=100)									
					水平面上円周方向の角度					φ(°)を中心とした傾斜の角度				
					0度	60度	120度	180度	240度	300度	光軸上	30度	60度	120度
本発明実施例 発光φ(°)	1	(Ba <sub>0.5</sub> Er <sub>0.5</sub> )Cl <sub>2</sub>	10	550	80	80	80	80	80	80	100	95	80	30
	2	(GdBr <sub>2</sub> ErBr <sub>2</sub> ) <sub>0.5</sub> (ZnBr <sub>2</sub> ) <sub>0.5</sub>	20	550	83	83	83	83	83	83	100	95	83	35
	3	GdBr <sub>2</sub> (Ba <sub>0.5</sub> Er <sub>0.5</sub> )Cl <sub>2</sub>	30	555	85	85	85	85	85	85	100	95	85	35
従来実施例 発光φ(°)	1	(Ba <sub>0.5</sub> Er <sub>0.5</sub> )Cl <sub>2</sub>	10	550	60	45	45	60	45	45	100	95	60	< 5
	2	(GdBr <sub>2</sub> ErBr <sub>2</sub> ) <sub>0.5</sub> (ZnBr <sub>2</sub> ) <sub>0.5</sub>	20	550	50	40	40	55	45	40	100	95	50	< 5
	3	GdBr <sub>2</sub> (Ba <sub>0.5</sub> Er <sub>0.5</sub> )Cl <sub>2</sub>	30	555	45	30	35	50	30	34	100	95	45	< 5

[0010] In addition, although the inside of the aforementioned dome-like molding object is coated with the coat which reflects the light although infrared light penetrates in this invention light emitting diode or the light similarly penetrates superficies, if infrared light carries out coating processing with the coat to reflect, it can raise brightness much more. Furthermore, in order to protect a light-emitting part, you may fill up the interior of a fluorescence molding object with a transparent resin.

[0011]

[Effect of the Invention] It has a useful property on industry for the clear display of them to be conventionally, attained, even if this invention conversion light emitting diodes 1-3 show intensity with dispersion it is remarkable, is few and uniform by the position of observation and directivity makes them large-sized few therefore extremely as compared with conversion light emitting diode etc. so that clearly from Table 1.

[Translation done.]



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The cross section of this invention conversion light emitting diode

[Drawing 2] The cross section of the conventional conversion light emitting diode

[Description of Notations]

1. Diode Chip

2. Fluorescence Molding Object

3. Space

4A,4B. Metal stem

5A,5B. Terminal

6. Lead Wire

7. Transparent Resin Mould

8. Fluorescent Substance Layer

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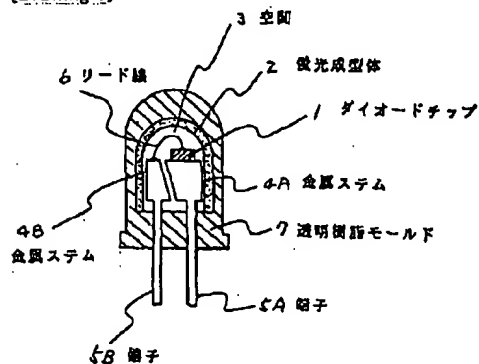
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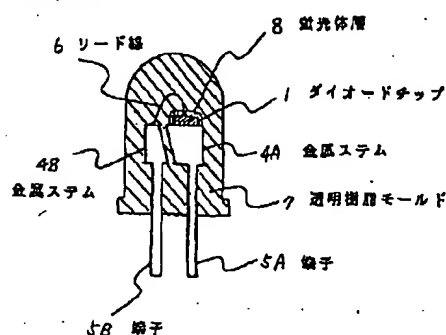
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## DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]